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RESIDENTIAL GAS COMBUSTION VENTING ISSUES FORUM

June 18 & 19, 1987

PROCEEDINGS

Prepared for:

CANADA MORTGAGE AND HOUSING CORPORATION

Prepared by:

ASHTON AND ASSOCIATES LTD.

in association with

RESOURCE INTEGRATION SYSTEMS LTD.

Table of Contents

1. Background and Objectives of Forum 1

2. Forum Agenda 2

3. Summary of Presentations and Question Period 4
   - 3.1 Review of the Building Code, Then and Now 5
   - 3.2 Exposure Guidelines for Residential Indoor Air Quality 7
   - 3.3 Combustion Venting Research, Issues & Needs 10
     - 3.3.1 Combustion Venting: Research & Issues 10
     - 3.3.2 Combustion Venting: Research Needs 14
   - 3.4 Issues and Implications: A Gas Industry View 15
   - 3.5 Venting Interactions: An HRAI View 18
   - 3.6 A Manufacturer's View 20
   - 3.7 Question Period 23

4. Summary of Group Discussions 25
   - 4.1 Issues Inherent in Research Findings 25
     - 4.1.1 Issue 1: All the knowledge needed is not available 25
     - 4.1.2 Issue 2: The lack of qualified tradespeople 27
     - 4.1.3 Issue 3: The lack of appropriate appliances 29
     - 4.1.4 Issue 4: Existing codes do not reflect our understanding of the house as a system 30
   - 4.2 Problems and Solutions 33
     - 4.2.1 Issue 1: All the knowledge needed is not available 33
     - 4.2.2 Issue 2: The lack of qualified tradespeople 37
     - 4.2.3 Issue 3: The lack of appropriate appliances 42
     - 4.2.4 Issue 4: Codes and standards 45
   - 4.3 Action Plan Summaries 50
     - 4.3.1 Building Code Action Plan 50
     - 4.3.2 Fuel Safety Action Plan 53
     - 4.3.3 Standards and Testing Action Plan 53
     - 4.3.4 Manufacturers' Action Plan 54
     - 4.3.5 Utilities' Action Plan 56

4.3.6 Researchers' Action Plan 57
4.3.7 "Others" Action Plan 57

5. Closing Summaries 59
5.1 Manufacturers' Viewpoint 59
5.2 HRAI Viewpoint 61
5.3 Utilities Viewpoint 63
5.4 Government Viewpoint 65

Appendix A: List of delegates and table assignments

1. BACKGROUND AND OBJECTIVES OF FORUM

Section 1: BACKGROUND AND OBJECTIVES OF FORUM

Canada Mortgage and Housing Corporation (CMHC) has been conducting research into venting in Canadian housing since 1982. To initiate the dissemination of these research efforts, CMHC prepared a draft Communications Strategy based on research findings and on extensive discussions with various industry and governmental agencies.

The major thrust of the Communications Strategy focused on working cooperatively with industry and included: informing industry of research findings; involving industry in evaluating the results of the research; obtaining the participation of industry in the development of a communications plan; establishing the role of industry in the development and delivery of training programs; and working with industry to upgrade the quality of servicing of combustion and related equipment.

The Communications Strategy called for an initial workshop to initiate the exchange of information and obtain the views of industry on their needs and roles. The Canadian Gas Association (CGA) suggested that this take the form of a joint industry/government forum. The Heating, Refrigeration and Air Conditioning Institute (HRAI) also expressed interest in participating in this communications initiative.

On June 18 and 19, 1987, a joint industry/government Residential Gas Combustion Venting Issues Forum was held. The Forum was sponsored and co-chaired by CMHC, CGA, and HRAI with financial assistance provided by Energy, Mines and Resources Canada.

The objectives of the Residential Gas Combustion Venting Issues Forum were twofold: firstly, to communicate, to various industry members and representatives, the findings of CMHC's Combustion Venting Research; and secondly, to engage industry in a cooperative effort aimed at determining the issues, potential implications and possible action plans derived from the research results. To focus attention on the objectives, and to facilitate the formulation of responses, the Forum incorporated several round-table group discussions.

2. FORUM AGENDA

Section 2: FORUM AGENDA

The two-day Forum agenda consisted of a welcome, followed by six presentations, three discussion periods, and a closing summary. A copy of the agenda is provided on the next page.

Welcoming remarks were given by Doug Stewart (representing CMHC), Ian MacNabb (representing CGA), and Warren Heeley (representing HRAI). All speakers expressed their enthusiasm and commitment to the Forum as a truely cooperative and meaningful industry/government initiative.

Jim White (CMHC) presented an overview of the agenda and assumed the role of moderator. The six presentations provided participants with information on the building code, exposure guidelines for residential indoor air quality, combustion venting research issues, and research needs. Three industry speakers presented the views of the gas industry, HRAI, and appliance manufacturers. Upon the completion of the six presentations, participants were able to comment and ask questions during a 25-minute question period.

Three round-table discussion periods were then conducted where participants were asked to react to the information provided during the presentations. Specifically, the participants were asked to explore the issues and implications (Discussion Period #1), identify problems and solutions (Discussion Period #2) and develop action plans (Discussion Period #3). When "issues and implications" and "problems and solutions" were discussed, fourteen tables, each comprised of a mix of industry groups, were formed. When action plans were formulated, six sets of tables were assembled, into single interest groups (building code, standards, testing, manufacturers, utilities, researchers, "others"). Each table was asked to present their findings to the audience at large during each of the three "Round Table Summary" sessions. The following four issue statements were explored during the question period:

i) All the knowledge needed is not available;
ii) There is a lack of qualified field people to service the industry (designers, installers, etc.);
iii) There are not appropriate appliances and equipment or products available at a reasonable cost;
iv) Existing codes and standards do not reflect our present understanding of venting (House-as-a-System).

Four facilitators circulated around to each of the discussion groups and assisted the various tables in their discussions. Jim White (CMHC) facilitated discussion relating to knowledge issues, Doug Geddes (HRAI) facilitated discussion relating to training, Dave Robertson (KeepRite Inc.) assisted the groups involved in discussing appliance issues, and Ran Hay (CGA) facilitated group discussions relating to codes and standards.

To close the Forum, Dave Robertson (manufacturers), Doug Geddes (HRAI), John Graham (utilities), and Jim White (CMHC) made summary comments on the group findings, and in some cases expressed additional views reflecting the particular interests of their industry.

NOTE: This document attempts to summarize the Forum as it occurred. Some of the attendees were hearing the presentation data for the first time. As such, there was a natural development of understanding and consolidation of positions, which is apparent within this summary document. In some instances, subsequent review of the background documentation has or will result in a change in comprehension and positions on some issues. A subsequent, shorter document is being considered to assemble resulting views of the major participants.

3. SUMMARY OF PRESENTATIONS AND QUESTION PERIOD

Section 3: SUMMARY OF PRESENTATIONS AND QUESTION PERIOD

The forum agenda began with six presentations which were intended to provide the necessary background information for delegates and which would help to stimulate discussion.

Six presentations were made:

1. Review of the Building Code, Then and Now: by G. Wilson (Consultant).

2. Exposure Guidelines for Residential Indoor Air Quality: by V. Armstrong (Health and Welfare Canada).

3. Combustion Venting Research and Issues and Venting Research Needs: by J. White (CMHC).

4. Issues and Implications: A Gas Industry View: by J. Graham (Consumers Gas).

5. Venting Interactions: An HRAI view: by D. Geddes (HRAI).

6. A Manufacturer's View: by D. Robertson (KeepRite Inc.).

Transcripts for five of the six presentations were provided to each delegate as part of the Residential Gas Combustion Venting Issues Forum Delegate Kit. A transcript of the Exposure Guidelines Presentation was not available, given the draft nature of the guidelines presented. (These guidelines were subsequently released on August 14, 1987, and are available from the Communications Directorate, the Department of National Health and Welfare, 5th floor, Brooke Claxton Building, Ottawa, K1A 0K9.) A related paper entitled: Development of Canada's Guidelines for Residential Indoor Air Quality was included in the Delegate Kit.

Brief summaries of the presentations are provided in the following section. Readers are asked to reference the Delegate Kit for the more complete text of the presentations.

3.1 Review of the Building Code, Then and Now

Mr. Grant Wilson, a building science consultant currently associated with Ashton and Associates Ltd., presented a review of the history, structure, and objectives of the National Building Code of Canada (NBCC) and provisions related to combustion venting.

The first NBCC (issued in 1941) represented an attempt to initiate some measure of uniformity into building by-laws which, at that time, were the responsibility of some 4,000 individual municipalities. Over the past 20 years, the objective of uniformity has largely been achieved as a result of provincial governments enacting legislation for uniform provincial codes (e.g. by making direct reference to the NBCC or by using the NBCC as a base document).

New editions of the NBCC are issued, at five-year intervals, by the Associate Committee on the National Building Code of the National Research Council. Responsibility for revising the Code is assigned to a number of standing committees whose membership is intended to provide appropriate building industry and geographic representation.

The NBCC is a set of model technical requirements, primarily with respect to occupant safety and health in buildings. The Code makes reference to a number of specialized safety codes and standards promulgated by standards organizations such as the CSA, ULC, CGSB and CGA.

For practical reasons, many of the Code provisions are written in prescriptive terms, rather than as statements of a performance objective with quantitative performance criteria. Prescriptive requirements, by their nature, limit solutions, whereas performance criteria allow for the development of alternate solutions. The performance approach is, however, effective only when performance objectives can be quantified and design methods are available to predict if alternate solutions meet the objectives. Expressing requirements in performance terms is, therefore, appropriate only where the knowledge is highly developed and there is adequate training at all levels. Because prescriptive requirements describe a solution it is easier to establish compliance.

Part 9 of the NBCC, which deals with houses and small buildings, states most requirements in prescriptive terms, although there is

increasing use of performance criteria at the component and sub-system level, as knowledge increases and the industry becomes more sophisticated.

Specifying performance objectives for an individual component may often be appropriate, but a systems performance objective will be required whenever the performance of the system is affected by interaction of the components. For example, it is now becoming apparent that the natural draft venting of fuel-fired appliances in houses is a systems-level process, affected by the characteristics of the house, other appliances, and their use by the occupants. There is a growing recognition that it will be necessary to establish some performance criteria at the house system-level that address this issue.

The R-2000 Guidelines have taken a systems approach, calling for maximum levels of airtightness and specifying the maximum allowable values of house pressurization and depressurization due to operation of mechanical ventilation systems and exhaust appliances. The CSA F326 draft standard, on Ventilation Requirements for Residential Construction, is taking a similar approach. The current draft standard specifies maximum values of house depressurization based on the characteristics of the combustion venting system, and maximum values of pressurization based on house tightness because of concern for condensation problems. Account is taken of all openings and appliances that exhaust or supply air. It is assumed that there is specific provision of air required for vented combustion appliances.

If the F326 Committee is successful, the draft standard will provide a systems level approach for new houses, to deal with combustion venting problems related to house depressurization. Introduction of new performance criteria, at the systems-level, requires development and communication of technology throughout the industry, as well as coordination and cooperation in its application. Although it allows optional solutions to the stated objectives, it is more demanding on all concerned than a simple prescriptive requirement that states essentially one solution.

3.2 Exposure Guidelines for Residential Indoor Air Quality

Dr. Vic Armstrong of Health and Welfare Canada, presented information that supplemented what was provided in the Delegate Kit. Dr. Armstrong's presentation included the following:

- Health and Welfare sees the phenomena of poor indoor air quality as a health issue and therefore has become involved;

- A significant amount of time is spent by people indoors;

- Dr. Armstrong presented seven strategies for controlling concentrations of indoor air contaminants and suggested that an effective approach may require the use of some or a combination of all seven:

    1. Ventilation
    2. Source Removal or Substitution
    3. Source Modification
    4. Contaminant Removal or Reduction
    5. Certification Programs for Builders and Tradespeople
    6. Mandatory Courses for Engineers, Building Designers
    7. Public Education and Information;

- There is a need for a yardstick with which to judge if measures to affect indoor air quality are adequate;

- The guidelines encompass the general population and individual subgroups such as: children; pregnant women; the elderly; and the infirm, needing lower levels than healthy, male workers. They may <u>not</u> be rigorous enough to satisfy the needs of the hypersensitive portion of the population;

- Dr. Armstrong described the structure, membership and objectives of the Federal-Provincial Advisory Committee on Environmental and Occupational Health. A working group (Dr. Armstrong was the secretary of this working group) was formed to develop guidelines for residential indoor air quality;

- Dr. Armstrong presented a definition of "what is good air quality" which included consideration of biological, physical, and chemical contaminants;

- Sources and types of indoor air pollutants were presented;

- A list of contaminants which the Working Group had reviewed was presented;

Contaminants with Ranges Specified	Contaminants for Exposure Avoidance
Aldehydes - Formaldehyde - Total Aldehydes	Biological Agents
	Chlorinated Hydrocarbons
Carbon Dioxide	Fibrous Materials
Carbon Monoxide	Lead
Nitrogen Dioxide	Polycyclic Aromatic Hydrocarbons
Ozone	Product Aerosols
Particulate Matter	Tobacco Smoke
Radon*	
Sulphur Dioxide	
Water Vapour	

- A description of the process for developing health guidelines was provided which included a discussion of the various factors that are considered in setting standards (e.g. background levels, detection limits, technological feasibility, economics, and health effects), dose response curves, and definitions for the Acceptable Long-Term Exposure Range (ALTER) and the Acceptable Short-Term Exposure Range (ASTER);

*It was decided to refer Radon to a separate committee

- The potential health effects of various combustion products were discussed;

Contaminant	Some Possible Health Effects
Aldehydes	eyes, nose, throat irritation
Carbon Dioxide	Acidosis
Carbon Monoxide	Impaired cardiovascular system
Nitrogen Dioxide	
Ozone	Respiratory disease; irritation; impaired lung function
Particulate matter	
Sulphur Dioxide	

- Proposed ASTER and ALTER guidelines for a group of substances (aldehydes, carbon dioxide, carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulphur dioxide, and water vapour) were provided and discussed. A proposed ASTER and Target and Action Levels were given for formaldehyde.

3.3. Combustion Venting Research, Issues and Needs

3.3.1 Combustion Venting Research and Issues

Mr. Jim White, a Senior Researcher with the Canada Mortgage and Housing Corporation (CMHC), presented a review of CMHC's combustion venting research activities and results.

Mr. White introduced his presentation by providing background information on the following:

- Research findings from "The Hatch Report"* which surveyed the incidence of carbon monoxide episodes in housing;
- Results of equivalent leakage area studies in existing houses, including new houses built in 1981, prewar houses through to 1980 in Saskatoon, 1940's Winnipeg wartime houses;
- CMHC Research Advisory Committee members and the advisory process;
- The CMHC research program and communications strategy.

A description of the various system properties of the house and the interactions that influence the performance of natural draft venting systems was then presented. This included:

- House venting systems, the house as a chimney, chimney performance, the appliance as a vent, and combustion system interactions.

The FLUESIM analysis program and the related research findings were described. They included:

- Normal levels of house depressurization can increase spillage and create backdrafts;
- Furnace and vent connectors can be pressurized during start up. Leaks will spew pollutants into the house, when combustion is at its most incomplete;

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* Hazardous Heating and Ventilating Conditions in Housing by Hatch Associates, Toronto. A CMHC publication.

- From the backdrafting point of view, tight houses with small exhaust flows are no worse than leaky houses with large exhaust flows. Pollutant levels may be worse in the former.

Field test procedures and the field test survey design, survey results and problem house case studies were then presented:

- 10% of houses heated with gas had "higher than normal" spillage incidents;
- Only 25% had no spillage incidents;
- 55% of houses heated with oil had significant spillage incidents; oil spillage sensors may have reacted too quickly, when the barometric damper was stuck, yielding uncertain research results;
- Spillage is truly a systems problem, with several contributing factors;
- Most spillage is due to depressurization, but tightness is sometimes implicated, excessive fan capacity is sometimes suspected, fireplace use and flow is a contributor;
- Poor chimney performance is often implicated;
- Poor maintenance is sometimes a problem;
- Service personnel could neither "see" nor solve most problems.

An in-depth presentation of remedial measures was provided including discussion of: draft inducers, fresh air supplies, improved chimneys, powered venting, control and warning devices, and vent dampers. Vent dampers were found to create problems - not solve them.

Air quality impacts related to carbon monoxide, carbon dioxide, and nitrogen dioxide were discussed.

A summary of the findings and issues was then made according to five categories:

1. The house-as-a-system

- Both air and energy flows are dependent on the interaction of systems and devices. Their performance cannot and must not be defined in isolation;

- The house is a good chimney, in the heating season, because it has an effective height and is filled with warm air;

- A combustion appliance is, therefore, contained in one chimney and trying to vent through another.

2. Ventilation interactions

- To a good first approximation, air throughout the house is equally influenced by any supply or removal flow and/or pressure drop. Being closer to an intake makes little difference in the ability of an appliance to obtain air from that intake;

- Exhaust fans and fireplaces are much more powerful extraction devices than any of the naturally aspirating appliances. The competition is not even close. Powered venting appliances may be at a disadvantage during start-up;

- Fresh air openings must be very large to supply significant quantities of air, at the low pressure drop needed to prevent spillage. Cold drafts can then be a crucial problem. Wind effects can make intended intakes into competing vents.

3. Chimney performance

- Uninsulated and oversized chimneys are very poor venting devices, because the loss of heat leads to a loss of available draft;

- Exterior chimneys produce a lower draft than interior chimneys during the critical furnace-off cycle, and thus cause more spillage when the appliance starts;

- Insulation of vent connectors improves draft during operation, and helps avoid condensation problems, but does not help off-cycle draft;

- Leaks in vent connectors and chimneys can cause very poor draft and therefore cause an increase in the amount of spillage.

4. Appliance performance

- Naturally aspirated gas appliances with draft hoods cannot reverse cold, stable backdrafts, but can sometimes reverse cool-condition backdrafts;

- Venting systems serving powered vent appliances should be very well sealed, to prevent spillage while chimney draft is being developed;

- Powered vent appliances must be capable of initiating venting against a stable, cold backdraft. That condition may become very common in some houses.

5. System performance

- High-flow exhaust devices must be supplied by large, matched-flow supply fans;

- The National Building Code of Canada is the only document that can possibly encompass all of the provisions required to deal with interactions affecting venting performance;

- No combination of devices should be capable of depressurizing a house by more than four Pascals;

- Each exhaust device, including combustion appliances, should be capable of safely exhausting with a house depressurization of five pascals, with a margin of safety dependent on the impact of a failure to vent.

3.3.2 Combustion Venting Research Needs

Jim White concluded his presentation by addressing venting research needs. He indicated that we needed to know more about the following things: ventilation balancing, chimney performance, solid-fuel appliance performance, remedial measures, code and standard changes, industry training needs, and consumer education programs.

3.4 Issues and Implications: A Gas Industry View

Mr. John Graham, of Consumers Gas Ltd., presented the gas distributors' position. He began by explaining that the Canadian Gas Association (CGA) is comprised of 550 corporate and individual members with the mandate to support the efficient use of natural gas for all Canadians.

Mr. Graham then drew attention to the recent increase in public, industry, and government awareness regarding indoor air quality. He expressed the opinion that, in spite of an increase in awareness, we have not established standards as to acceptable levels of exposure to these pollutants. The CGA and gas utilities strongly support increased public awareness, open discussion, and responsible, practical solutions to the issue of improving indoor air quality. Specifically, Mr. Graham indicated "discomfort" with unilateral action taken by associations or government bodies. He expressed support for the following:

- continued research and review of regulations in support of healthy indoor environment;
- continued co-operation between provincial and federal governments and industry to address the issue; and
- the use of a consultative approach which accesses experience and expertise, not just within the gas industry, but within government and affiliated agencies.

Mr. Graham then listed examples of projects relating to combustion and venting in which the gas industry has been involved, such as the development of new heating equipment, the development and evaluation of pollutant detection equipment, and the investigation into combustion venting issues and problems.

In addition, Mr. Graham described the CGA Committee on indoor air quality and its objectives:

- Providing information and expertise on indoor air quality to the public;

- The development of standards of manufacturing and installation;
- The collection and sharing of information;
- Liaison and co-operative work with external groups;
- The review of existing and proposed standards, codes, and legislation;
- Co-operation with the public and government in the development of knowledge about indoor air quality issues;
- Participation in the development of external research programs;
- Promotion of effective development and implementation of indoor air quality legislation.

Mr. Graham outlined relevant historical developments. In the past, fossil-fueled equipment and fireplaces have relied on the natural leakage and ventilation inherent in the house design to supply adequate combustion and dilution air. Existing leakage and ventilation in houses today are being eroded with the continued emphasis on energy conservation and generally tighter construction practices.

Mr. Graham then went on to address the house-as-a-system and the application of codes. Mr. Graham believed that it was within the public interest that codes address the house-as-a-system and indicated further that public awareness should receive high priority in conjunction with the application of revised codes. To support this position, Mr. Graham indicated that in his business, virtually 100% of the gas-related safety problems that are investigated are related to the actions of a homeowner or tenant.

Concerning the issue of air competition within the home, Mr. Graham suggested that perhaps the best method might be to insist that all exhaust devices must, as a part of their design, incorporate replacement or make-up air.

Regarding backdrafting chimneys and spillage of combustion products, Mr. Graham summarized the problem areas as follows:

- blocked or poorly maintained chimney;
- oversized chimney;
- tight house with heavy air competition;
- equipment failure;
- poor maintenance;
- any combination of the above.

In addressing these problem areas, Mr. Graham again placed a high priority on public awareness and indicated his support for installation codes and building codes which address these issues.

In regards to the effects of indoor air quality on long-term health, Mr. Graham expressed a concern that the issue was subject to wide ranges of opinion and conjecture. Mr. Graham proposed that allowable levels of pollutants and time of exposure must be defined, based on scientific judgement and allowing for practicality and acceptable risk.

In closing, Mr. Graham expressed the support for a consultative approach to research, testing, and standard amendments. Mr. Graham cited that the gas industry needs more representation on the NBCC and similarly, the NBCC should be more involved with the gas codes.

3.5 Venting Interactions: An HRAI View

Mr. Doug Geddes began by stating that combustion backdrafting and spillage is usually a house-as-a-system problem. A naturally aspirating gas-fired appliance, when installed properly, is unlikely to backdraft unless another appliance causes it to do so. As houses are made tighter, it becomes easier for other exhaust devices to backdraft naturally aspirating appliances.

Mr. Geddes expressed the opinion that the burden of ensuring that combustion appliances vent properly in new, tighter houses has been placed on the heating industry rather than on the manufacturers of exhaust devices such as bathroom fans, range hoods, and other exhaust equipment, which usually induces the spillage.

Mr. Geddes believes that a house can be designed to operate as a system, even with a naturally aspirating appliance, provided the designer and builder understand the interaction between exhaust and supply devices. The job of a designer could be made much easier if changes to the design of competing appliances were made. However, most of the appliances which interact in a home are regulated by non-interactive codes and standards.

Mr. Geddes indicated that the NBCC has the potential and responsibility to ensure that the house works as a system. However, Mr. Geddes expressed concern that a restructuring of the Code has made the house-as-a-system concept more difficult to address. Mr. Geddes expressed the opinion that the moving of the requirements relating to residential heating and cooling, from Part 9 into Part 6, has had the effect of allowing residential HVAC systems to become a "NBCC refugee, at a time when their impact on house safety, comfort, and efficiency is becoming more recognized." Mr. Geddes suggested that perhaps there should be a restructuring of the Part 9 Committee and mandate, such that there are two parts, one structural and one mechanical, each meeting separately, but also meeting together in order to deal with house as a system issues.

To ensure proper sizing and installation of heating systems, Mr. Geddes advocated that other provinces adopt the Ontario Building Code provision (Part 11) that requires a permit be obtained and an inspection made whenever a heating system receives a substantial alteration.

Again, considering the NBCC as the logical medium to deal with the house-as-a-system, Mr. Geddes suggested that all related standards, codes, and regulatory authorities must be co-ordinated to ensure compatability, enforceability, and flexibility. Mr Geddes cited examples of the need for co-ordination between the NBCC and the CGA, the HRAI, the CSA, the ULC, Fuel Safety Branches, Provincial Building Branches and the Utilities. In addition, there is a need for someone to co-ordinate the co-ordinators. Mr. Geddes believes that this is being done by the HRAI for its own purposes and that the HRAI might expand its role to "encompass and benefit other parties."

Mr. Geddes described the HRAI's role in bringing the house-as-a-system concept to industry. Mr. Geddes cited the HRAI Total Tune-up program as a possible vehicle to conduct back-drafting tests. In addition, Mr. Geddes cited past activities such as the HRAI-sponsored House-as-a-System training courses and the incorporation of house-as-a-system concepts into existing HRAI manuals such as the new HRAI Residential Air System Design Manual. Currently, the HRAI is co-ordinating final funding and support for the production of a computer version of the HRAI Residential Air System Design Manual that has the potential to predict house pressures, ensure compliance with the new CSA residential ventilation standard, and ensure that naturally aspirating appliances do not excessively spill or backdraft.

Mr. Geddes closed his presentation by indicating that the HRAI is in need of support and co-operation from standards writing organizations, regulatory authorities, and utilities.

3.6 A Manufacturer's View

Mr. Dave Robertson of KeepRite Ltd., a major Canadian manufacturer of heating, air conditioning, and refrigeration products, was asked to address the manufacturer's viewpoint. Mr. Robertson began his presentation by advising that manufacturers require the following actions in order to continue to manufacture safe, reliable, and efficient products that are cost-competitive in the marketplace:

- Be cautious in making Code changes that are not fully justified;
- Take time to be sure of the facts;
- Give manufacturers sufficient time to make modifications and to ensure that they work as intended.

Mr. Robertson then went on to comment on the CMHC research which he believed demonstrated that a well-installed and maintained atmospherically-vented gas furnace or water heater does not suffer from combustion backdrafting provided the house is not too tight and the chimney is in good shape. Mr. Robertson commented that the CMHC report concluded that some spillage is occurring. However, in response, Mr. Robertson stated:

> "I am afraid we are a long way from a definitive assessment of what the problem is, how serious it is, and what to do about it."

Mr. Robertson outlined the various ways in which the manufacturing industry had reacted to protect the consumer from a potential problem:

- Information mailouts on combustion air and venting have been sent to all utility customers;
- Changes have been made to the B149 code to more clearly define requirements to ensure adequate combustion air;
- A task force to review the standard for high-efficiency furnaces with dedicated venting systems has been created;
- Mid-efficiency, power-venting furnaces have been fitted with vent safety or spill switches for the past two years;

- As of July 1, 1987, all atmospherically-vented furnaces will be equipped with vent safety switches.

Mr. Robertson believes that these measures provide some "breathing space" to conduct further research and amend codes where necessary.

Mr. Robertson then addressed the issue of protection for existing homeowners who already have a gas furnace and who are renovating to increase airtightness. Mr. Roberston recommended the following:

- Continue utility mailings;
- Train all gas inspectors to recognize and/or conduct tests where backdrafting could be a problem;
- Train all current and future applicants for gas fitter licenses to recognize and/or conduct tests where backdrafting could be a problem;
- Encourage the development of low-cost pollutant detectors (not the "dot" spillage heat detectors which can be easily misinterpreted);
- Ensure that all airtightening renovations are inspected.

Mr. Robertson also suggested that code changes must be made which recognize changes in house construction and increasing knowledge of the health effects of various pollutants. To help to accomplish this, Mr. Robertson recommended the following:

- Continued research into the health effects of various pollutants;
- Restructuring of codes and the NBC committee membership to better recognize the house-as-a-system principle;
- Direct attention to the overall indoor air quality rather than concentrating on combustion appliances;

- Conduct field testing of the proposed CSA ventilation standard to ensure that it isn't "overkill" and that it is workable;

- Do not make public statements that can lead to misinterpretations and unnecessary concern;

- Do not panic or over-react.

Mr. Robertson then went on to react to what he felt were some signficant biases in the issues and implications discussion of the CMHC research report. Mr. Robertson commented critically on the following three quotations:

- "Spillage from natural draft appliances is more common than previously believed."

- "Flue dampers may exacerbate venting problems in some installations."

- "Equipment certification should specify the performance characteristics of the flue necessary for efficient and safe operation."

Mr. Roberston concluded by making four summary points:

- The implications of changes to standards and codes are not always fully thought out;

- When more expensive gas appliances are forced on the consumer, it creates an incentive to patch and "band-aid" the old furnace;

- We must not give the impression of "gas being the bad guy." All heating systems pollute in some way, and;

- Manufacturers may be well concerned about profit, but will not remain in business very long without regard for safety.

3.7 Question Period

A question period was conducted after the completion of the six presentations. A summary of the issues raised is provided below.

Poor Communication and the Mechanism for Public Review

Regarding the issue of poor communication, it was suggested by a representative of the gas utilities that good bonds for communication do exist but people are unaware of them. Further, it was expressed that a perfect NBCC was an impossibility given that it must continually evolve. Mr. Geddes responded in agreement but suggested that there is a lack of reporting back of information by the various committee members.

The mechanism for public review was explained and it was noted by a code representative that anyone who owns a code or is on the NBCC mailing list would receive notification of technical changes. The Code procedures also require that every technical change go out for public review and comment, and that each comment is addressed.

Additional Knowledge

A researcher addressed the issue of "possibilities" versus "probabilities" by suggesting that we are currently lacking a good assessment of probability and wanted to know whether probability would be addressed. Mr. White responded by indicating that parts of the CMHC research were meant to give an indication of probability but that he hoped further clarification could be provided in the future.

Another researcher questioned whether there really was a spillage problem and stated the need to define the problem more clearly (i.e. what is the incidence of spillage?). He suggested that ventilation is a problem, but questioned whether we had clear evidence of a spillage problem. Some of the conclusions of the CMHC report were questioned, and the question was asked whether the materials were considered final or draft. Mr. White responded by indicating that the reports were draft final, awaiting review by the industry and others, and that more detailed background reports are available which indicate the exhaustive nature and scope of the research undertaken.

Misconceptions

A gas utility representative expressed a concern that there exists a misconception regarding the health effects of nitrogen dioxide spillage from gas ranges. Reference was made to research findings from Ohio State which indicated a lack of adverse health effect from nitrogen dioxide (NO_2) spillages. It was further suggested that tobacco is by far the most serious of the indoor air pollutant sources. Dr. Armstrong responded by clarifying that there the issue of NO_2 had caught public attention but that, in fact, other studies had indicated the lack of a problem and that more research was underway. However, Dr. Armstong pointed out that NO_2 is toxic at certain levels.

Exposure Guidelines

A representative of the Codes and Standards Industry, asked Dr. Armstrong to indicate what needed to be done before exposure guidelines could be used as regulatory guidelines. He recommended that too often guidelines go on to become standards. Dr. Armstrong responded by discussing an analogous problem of enforcement of ambient air standards. It is impossible to enforce an ambient air standard, so instead, controls are put on the various sources of pollution (e.g. cars and industry). With respect to buildings, ASHRAE is currently developing standards for buildings which specify an air change rate and specify the acceptable levels of contaminants.

A government representative suggested that consultation with industry and the public sector was necessary prior to the establishment of guidelines. Dr. Armstrong responded by offering to address this suggestion to the Advisory Committee.

4. SUMMARY OF GROUP DISCUSSIONS

4.1 Issues and Implications

4.2 Problems and Solutions

4.3 Action Plan Summaries

Section 4: SUMMARY OF GROUP DISCUSSIONS

4.1 Issues Inherent in Research Findings

Participants were asked to explore the problems and implications of the following four issues in relation to the venting of gas-burning appliances:

1. All the knowledge needed is not available.
2. The lack of qualified tradespeople.
3. The lack of appropriate appliances.
4. Existing codes and standards do not reflect our present understanding of house-as-a-system.

4.1.1 Issue 1: All the Knowledge Needed is Not Available

Three tables were asked to respond and to suggest issues and implications related to the above statement. **All three tables were of the opinion that all of the knowledge needed is not available.**

Specifically, the participants cited a need for additional knowledge in the following areas:

- **How much spillage/backdrafting is actually occurring in houses?**
- What is the **extent of the health hazard** from actual combustion spillage?
- Regarding exposure guidelines, one table presented the opinion that more information was needed, however, consensus was not reached as to "how much spillage is too much spillage"?

- There is a need to better understand the behaviour of the **house operating as a system** (as opposed to individual sub-components);

- **Moisture problems** from backdrafting may need to be further investigated;

- Investigate **prevention** of spillage/backdrafting;

- Continue research into both **new and existing houses**. For new houses, the issue is one of design criteria. For existing houses, more information on remedial measures is needed.

Other issues identified by the groups were:

- **Who should co-ordinate the additional research that is required?** It was suggested by one table that a more "well-rounded solution" would result from involving a broad group of agencies in conducting additional research. Suggested agencies were: CMHC, Manufacturers, CSA, CGA, the building industry, and the energy industry. It was pointed out that certain groups have a natural incentive to conduct research, e.g., manufacturers must test equipment to ensure safety and to secure certification. However, it was proposed that CMHC might be the best group to co-ordinate additional research relating to the house operating as a system.

- Is there currently a lack of co-ordination, which contributes to our sense of a lack of knowledge? It was suggested that we could **further our understanding of how the house operates as a system if our current understanding of sub-components were better applied and shared.** An example was cited of how building code personnel could benefit from greater awareness of what is currently being done by others.

4.1.2 Issue 2: The Lack of Qualified Tradespeople

Four tables were asked to suggest issues and implications related to the above statement. Two of the four tables questioned the need for more qualified trades personnel, based on what they felt to be insufficient evidence of a problem. However, all tables then led into a discussion of a potential training program. There was consistent support among all four tables for training, especially concerning how the house operates as a system. There were numerous issues raised by each of the tables relating to the logistics, responsibility, and implications of a training program. These are documented below:

- Who is responsible for providing the training? Specifically relating to this question, who is responsible (and has liability) for the house operating as a system in new, R-2000, retrofit, and existing housing? What are the limitations of the liability?

- Considering all of the people who might work on any one house component, the potential audience for house-as-a-system related training is very large. Who should be trained and how do we reach all of the potential (and targeted) audiences? Some suggested potential trainees:

  Architects
  Designers
  Installers
  Code inspectors
  Heating contractors
  Electrical contractors
  Carpenters
  Bricklayers (chimney)
  Standards writers
  Appliance designers?

- Is there a need to train homeowners and how do you go about it? How do you deal with the problem of homeowners not performing routine maintenance?

- Is there a need to train do-it-yourselfers and how do you go about it?

- How will the following **logistics** be handled/resolved?

  - Where will the trainers come from?
  - What governing bodies will be involved?
  - Who will develop the training manual?
  - How long will the training program need to be operated?
  - How will the training be delivered in smaller centres?
  - How will regional differences be incorporated into the training materials and delivery?
  - What role might the community colleges play?
  - Who will pay for the training?
  - How will technical back-up support be provided?

- **How comprehensive** should the training be? What issues and what level of detail would the core content of the training address?

- **What will be the pass/fail grade?** Is anything less than 100% acceptable as a pass grade?

- Should training be tied to **certification or licensing?**

- Should **re-certification be required?** Should mandatory up-grading be required? How often for either?

- **Cost and funding** is a serious issue. Who will pay for the training? One of the tables questioned whether there was enough of a problem to warrant a potentially huge expenditure on training;

- Should manufacturers be more responsible for providing **instructions on product literature** relating to installation and how the application might impact on the house-as-a-system?

- There is a need to consider the potential role of **unions;**

- The question "**Is the R-2000 Program creating the very problem** it set out to solve?" was raised.

4.1.3 Issue 3: The Lack of Appropriate Appliances

Three tables were asked to suggest issues and implications relating to the above statement.

One table took the above statement as a given: that there are not appropriate appliances available at a reasonable cost. Specifically, it was proposed that manufacturers are not responding quickly enough for a number of reasons:

- lack of awareness of need;
- lack of resources to develop new products;
- lack of incentive - insufficient short-term profitability in developing new products.

This same table also put forward a suggestion that appliances are appropriate, but that other equipment which vents air from the house is inappropriate because the house is not being designed properly to meet competing demands for air.

Another table disagreed with the premise of the question posed, in as much as it implied a need for equipment revisions. This group questioned whether the existence of a combustion venting problem had been sufficiently demonstrated to warrant equipment modifications. Further refinement and study of venting problems would help to define the criteria that must be met when equipment is revised. For example, can occasional spillage be considered acceptable? Should the criterion be to completely eliminate all possible sources of combustion spillage? If so, then some of the current equipment is unsuitable.

Finally, the third table stated that equipment is evolving to meet the needs of the marketplace, but that the needs (relating to combustion venting) have not been clearly identified. It is not clear that the manufacturers should revise equipment prior to a clear demand (or need) being demonstrated. This group also raised the issue of a lack of awareness on the part of the homeowner (see point below) of the need for more expensive "upgraded" products.

All three tables addressed increased costs. Appropriate appliances are more expensive because of added controls or features.

What kind of additional costs can the market bear? Will consumers be willing to pay the price for a problem that is not significant enough to be general knowledge?

Various equipment needs were suggested:

- Integrated equipment for ventilating;
- Integrated equipment systems to supply air for competing demands;
- Self-balancing Heat Recovery Ventilators;
- Sealed barbecues;
- Sealed ranges and dryers;
- Sealed combustion equipment e.g. wood stoves and furnaces;
- CO sensors;
- Retrofit spillage switches;

Other issues raised by the three tables were:

- **Responsibility.** Who will take responsibility for solving the problem? Will it be the installer of the equipment, will there be revisions to envelope design, or will manufacturers have to resolve the problem?

- **Houses are not being designed as a system** to address competing demands for air;

- It is necessary to consider the **various categories of application** e.g. existing market, retrofit, and new homes.

4.1.4 Issue 4: Existing Codes do not Reflect our Understanding of the House-as-a-System

Three tables were asked to suggest issues and implications relating to the above statement.

All three tables made reference to an **incomplete understanding of the problem.** For example, one table questioned whether the problem was properly identified and documented. Another table

suggested that there was a need to focus on the probability (not the possibility) of a problem. And the last table suggested that our current understanding of venting was imperfect, therefore the codes could not possibly be perfect. This same table suggested that more research into system interactions within a house was needed.

All three tables also addressed the challenge of adapting the code in response to changing technology by providing the following comments:

- One group suggested that the **code system needs to be restructured so that it adapts to changing technology more readily.** This table then went on to propose that the purpose of codes and standards committees should not be to lead the industry, but to reflect the best current understanding. (In the case of venting, it was felt that current understanding was imperfect which has resulted in an imperfect code. The code currently allows each appliance to be considered in isolation from the house as a whole);

- **The second table suggested that codes did reflect current understanding.** In addition, this group suggested that there remains a challenge to get all of the components (such as venting, exhaust air, supply air, combustion air, dilution air) dealt with as a correlated whole;

- The third table raised as an issue the question of: **can the codes and standards react to requests for new technology? And, can we react quickly to new technology?**

Several tables addressed the issue of **information sharing and co-ordination** among the various industry groups involved with and affected by the code changes. Relating to information sharing, the following question/problems were raised:

- **How do we ensure a continued knowledge of all applicable codes and their contents,** and the recognition of the house-as-a-system principle **by all participants** (such as builders, installers and service people)?

- Is there a structured line of communication between consumer groups, industry, standards groups, and code writing officials?

- Does industry address its problems to the codes and standards groups for their attention?

- What, if any, is the relationship between the various code writing committees of the National Building Code of Canada?

- The building code does not truly represent the needs of the industry;

- Does the building code membership reflect the industry?

- There is a need to review the structure of the codes and standards committee. Specifically, representation by building contractors and housing inspectors should be considered.

Other issues:

- The Codes are only as good as their enforcement and their enforcement is only as good as the training of officials and their subsequent interpretation of the codes;

- No one group should be able to unduly influence the Code.

4.2 Group Discussion #2 Summary Report: Problems and Solutions

During this second group discussion session, participants were asked to propose problems and solutions related to the four issues (knowledge, training, appliances, and codes) previously discussed during Discussion Period #1. Prior to the beginning of Discussion Period #2, four brief summary presentations of the "Issues and Implications" were made by each of the four co-chairmen.

The co-chairman's summary for Issue 1 (information) was presented as follows:

4.2.1 Issue 1: All the Knowledge Needed is not Available

- More data is needed on several fronts:
  - extent and severity of actual spillage;
  - how much spillage is too much?
  - extent of health impacts; and
  - the extent of spillage as a source of moisture problems.
- A risk evaluation is required to define a justifiable degree of change.
- The CMHC should lead in co-ordination efforts because this is a house-as-a-system" problem (not just a combustion issue) and more work is needed on the inter-relationships.
- All affected parties have a responsibility to be involved at their own level.
- The issue to be addressed relating to new houses is design criteria (NRC-IRC).
- The issue concerning existing houses is remedial measures.

Three tables were asked to suggest possible problems and solutions corresponding with the above stated issues. A summary of their findings follows:

Additional Data

All three tables responded to the issue of additional data. In addition to general discussion, groups reported on data collection activities and sources of information.

Data collection and monitoring activities

Recommendations of the kinds of data collection and monitoring activities that should be undertaken are summarized below:

- Measure extent and severity of spillage of carbon monoxide, carbon dioxide, nitric oxides and water;
- One way to obtain more data on CO, CO_2, NO_x and H_2O would be to perform continuous monitoring of older and newer homes over an entire winter heating season, possibly using CO_2 as the indicator as it would be easiest to monitor;
- Continue study of indoor contaminant levels in homes (not just related to spillage from a specific appliance);
- Calculate maximum spillage limits which would be required to maintain safe levels (from the standpoint of dilution), using the minimum recommended air change rates (as specified in Canada and the United States);
- Determine long-term threshold limits from health impacts (Health and Welfare Canada);
- Establish guidelines for different climatic regions and housing types;
- Employ "test house" situations to experiment with various equipment components;

- Develop a checklist of "what to look for in problem houses" and identify where these houses are; and

- Conduct further research on induced draft fans.

Sources/Systems for more information

Suggestions as to how to collect more data, or for sources of information, were put forward:

- Develop a better reporting system by requiring service personnel (industry-wide) to report on Appliance Field Observation Report (AFOR) problems. Support this effort by training the service personnel in problem identification; and

- Survey the <u>available</u> data from across the country from government, industry, and technical people. Perform a technical review of all information and draw recommendations and conclusions based upon a technical interpretation.

General Discussion

One table reported having re-thought the issue of sufficient information and posed the following questions:

- Does the lack of data indicate we have a problem? or,

- Do we have enough data to say we do not have a problem?

Risk Evaluation

Two tables responded to the issue of risk evaluation and were in support of conducting a risk evaluation, in order to determine an acceptable level of risk. Mention was made of the various factors (e.g. cost benefit) that must be considered, and how difficult such an evaluation can be to perform.

CMHC Lead Role

Two tables responded to the issue of who should lead in the collection of additional data. It was agreed that one agency should lead (for both new and retrofit housing), however, neither table suggested CMHC as the appropriate agency. One table reported having debated whether the lead agency should be CMHC or the Associate Committee of the NBCC.

Responsibility of Affected Parties

There was general agreement with the issue statement that all affected parties have a responsibility to be involved at their own level. Additional comments included:

- All affected parties need to be kept informed in order to be properly involved;
- The gas industry must make sure the coordinating body has all of their information; and
- The Canadian Home Builders' Association (CHBA) should become more involved.

Design of New Houses

One group expressed the opinion that new housing design was the first priority.

Another table suggested that the current CSA standards addressed the issue (however, they were unsure, and therefore, further proposed that CSA could address new housing design safety standards.)

Retrofit Houses

One table suggested that resolving problems in retrofit housing was a secondary priority compared to addressing new home design. Subsequently, retrofit measures should be under the jurisdiction of local authorities and based on new codes.

Another table proposed that a methodology for assessing existing houses was needed. Further research is required to survey the possible impacts of retrofit measures (e.g. moisture, radon entry).

4.2.2 Issue 2: The Lack of Qualified Tradespeople

The co-chairman's summary for Issue 2 (training) was presented as follows:

- Who ultimately is responsible (has liability) for the house operating as a system in new, retrofit, and existing houses?

- a) Is training required?
  b) Who should be trained?
  c) Who should do the training?
  d) What should the content of the training be for each of the audiences?
  e) Who should develop and pay for the training materials?

- Should licensed installers be re-certified on a regular basis? How often? Should regular up-grading be required?

- If it is accepted that house-as-a-system training is required by the trades, what problems and restrictions may be encountered?

- a) How is training to be provided in the smaller communities and regions of the country?
  b) What back-up should be provided?

- a) How do we provide greater awareness to the homeowner?
  b) Should training be provided to the do-it-yourselfer?

- Is the R-2000 Program creating the very problem it set out to solve?

Four tables were asked to suggest possible problems and solutions corresponding with the above-stated issues. A summary of their findings follows:

Responsibility

Four tables responded to the issue of responsibility. One table indicated that they had spent time in discussion and concluded that ultimately, **no one person or organization can be fully responsible as it is too complex an issue.**

Concerning new construction, two tables suggested that the builder was responsible. Another table suggested that designers have responsibility for the issue, and the fourth table suggested that the Code must dictate proper practices in construction. All parties are then responsible for following the Code. Building inspectors are responsible to ensure that the builder has complied with the requirements.

Concerning retrofit houses, one table suggested that the homeowner must be responsible in retrofit housing. Another table suggested that the installer/contractor should be responsible for what is installed, however, this same table was unable to resolve two questions raised by group members:

- Does the installer's responsibility extend to all sizes of appliances (e.g. bathroom fans to power-vented kitchen fans)?

- Is the retrofit installer responsible for checking how well the house functions as a system?

Another table supported the view that whoever has been contracted to do the work has the responsibility to ensure the installation will not upset the balance within the system. To help support the installer/contractor in meeting this responsibility, it was suggested that installation instructions and post-installation test procedures be provided with each exhaust device.

Another table suggested that a permit and mandatory inspections be required for retrofit.

Concerning existing houses, one table suggested that the homeowner was responsible and that all affected groups, private and government, should continue to provide the homeowner with pertinent information.

Other discussion points included:

- Each appliance should specify make-up air requirements;
- Depressurization limits should be defined; and
- A spill switch may be a possible solution;

Logistics

a) Is training required?

Each of the four tables suggested that training was required. However, one table cautioned against "going too far."

b) Who should be trained?

Responses by each of the tables are listed below:

- Designers, installers (of all systems), homeowners, inspectors;
- Inspectors, architects, designers, builders, contractors (gas, electric, plumbing, carpentry), homeowners (there was some disagreement on which trades should be trained);
- Installers, manufacturers, builders, inspectors, designers, utilities (gas and electric), oil mechanics, and any other trades whose work is able to upset the air balance within the house; and
- Awareness of the house-as-a-system concept is needed for homeowners and for installers of all appliances (gas and others).

c) Who should do the training?

It was often expressed by the groups that the answer to this question would depend on who is being trained. Several agencies were suggested by each of the tables:

- HRAI, CMHC, community colleges, CHBA, Fuel Safety Branch;
- Community colleges, utilities, manufacturers, trade organizations, government agencies;
- The HRAI course is probably a good starting point, but all organizations need to be involved (manufacturers, builders, utilities, etc.).

d) Content of the training?

One table suggested that a modular approach be utilized whereby some sections would be required for all trainees while others would be written specifically for a particular trade.

Another table suggested that everything included in a house-as-a-system concept (e.g. venting, exhaust, make-up air) would be required as core training content.

e) Who develops and pays for training materials?

It was suggested that funding of training would involve several agencies. One table suggested that the sponsor would vary depending on the audience, but that it should involve industry, government, and the trainee. A second group suggested that regulatory agencies, the tax-payer, and the education system might share some of the costs. Another table suggested that the cost must be shared by both government and the private sector as a co-operative effort.

Re-certification

Three groups suggested that up-grading was desirable and needed (within one table there was one dissenting member). One table suggested that installers did not need to be re-certified, but that up-grading should be encouraged. Another table expressed concerns about the practicality of a re-certification requirement (e.g. mandatory re-certification is not currently required for other trades).

Two tables suggested that re-certification should be required every five years (equivalent to revision of the National Building Code of Canada).

House-as-a-System

One table expressed a concern that unions and tradespeople may be reluctant to accept added responsibility with respect to how a house operates as a system. Would we be asking too much of tradespeople?

Delivery

Several agencies were suggested as possible training agents in rural or remote regions of the country:

- Community colleges and community college extension courses at high schools
- Travelling seminars
- Utilities
- Building associations
- Correspondence courses.

The following agencies were proposed as appropriate to provide back-up support:

- CGA - installation manual as support to training;
- Regulatory agencies;
- Trade associations.

Do-it-Yourselfer

Public education was unanimously supported. The following methods were suggested:

- Public education using various media;
- Put temperature dot on furnaces to advise of problems;
- Utilities mail-out;
- Manufacturer's literature;
- Associations (e.g. CGA, CSA, the trade manufacturers);
- Distribution of pamphlets, HRAI information.

There was general support for providing training to do-it-yourselfers, however, one table was concerned as to how to achieve reasonable awareness? It was further suggested that manufacturer's instruction manuals include the necessary information and installation warnings related to air balance within the home.

R-2000 Houses

Three tables responded to this question. All three tables expressed the opinion that R-2000 was not creating new problems, but was uncovering problems that were already in existence (though relatively unknown).

4.2.3 Issue 3: The Lack of Appropriate Appliances

The co-chairman's summary for Issue 3 (appliances) was presented as follows:

- The term "appropriate" is not yet defined. Therefore, gas appliance manufacturers are not responding.

- Assuming that the problem is lack of air, do we need:
  a) Integrated appliances to assure proper venting?
  b) All appliances to have self-sufficiency as far as "air in" vs "air out"?
  c) To find out whether current furnaces and water heaters with sealed or power venting are reasonable in cost?

- Will consumers buy higher-priced appliances without awareness of potential problems?
- Have other gas appliance (e.g. clothes dryer manufacturers) responded?
- Have other air-using appliance manufacturers responded?

Three tables (12, 5, 3) were asked to suggest possible problems and solutions corresponding with the above-stated issues. A summary of their findings follows:

Need for Definition of the Term "Appropriate"

Although not directly stated by each of the three tables, the general consensus was that "appropriate" had not been fully enough defined and therefore appliance manufacturers had not responded. One table responded by stating that the required infrastructure for the house as a system was not present (e.g. training, Code integration, delegation of responsibility) therefore, at this point in time, it would be punitive for manufacturers to respond. Another table suggested that should indoor air quality be mandated, it would represent an opportunity for manufacturers to integrate appliances. Finally, the last table reported having had trouble defining "appropriate." The group was unable to agree on a complete definition but were able to resolve that if it were to be considered a safety issue, the responsibility would lie with codes and standards. Manufacturers would then respond to any code changes.

Need for Integrated Appliances, Self-Sufficient Appliances, Cost of Current Sealed Appliances

Several comments were made related to the need for integrated appliances:

- One table commented that components for an integrated system to handle the house as a system are currently available;

- Another table pointed out that there may soon exist an opportunity for manufacturers to develop more complicated equipment (double and triple integration). The need for lead time was discussed in order that manufacturers have enough time to develop new products, phase out old appliances, and bring in new ones;

- The last table made the point that an integrated system was not foolproof in as much as it is impossible to control homeowner ignorance.

All tables responded to the question: "should all appliances have self-sufficiency as far as air in/air out?" There was general support for self sufficiency with respect to air exhausting appliances. One table suggested that the NBCC should require any equipment which exhausts air to supply replacement air. Similarly, another table suggested that any equipment that exhausts air should specify the requirements for replacement air. Two tables, although they were in support of self sufficiency for air, mentioned increased cost as an important factor.

Responses to the issue of the current cost of sealed equipment were often grouped together as a general discussion point within the following question which also dealt with cost.

Acceptance of Higher Prices

It was generally felt that consumers had to have an awareness of the need for more expensive and complex appliances. An effort to educate consumers about the potential problem was suggested to be necessary.

One table discussed the issue of cost and pricing in more detail by pointing out general pricing circumstances:

- For new and tract construction, work is performed on a bid basis, therefore, products tend to meet only the minimum standards. On the other hand, selling to the replacement market involves one-to-one selling, therefore, added value to a product is easier to sell. For custom built homes, the selling opportunity was described as falling somewhere in-between new and replacement.

Response of Other Gas Appliance Manufacturers

The general opinion was that other gas appliance manufacturers have not responded, either because the need has not been well defined or because it was felt to be unrealistic to single out "other" gas appliances when other types of exhaust appliances such as exhaust fans have not responded.

Additional comments included:

- If we do not accept the house-as-a-system concept, each piece of equipment should be designed to stand alone and meet specific standards. This would require installation training;
- Can or should other strategies be explored?

Response of Other Air-Consuming Appliance Manufacturers

It was felt by all tables that other air-consuming appliance manufacturers had not responded. Again, however, it was suggested that the need for a response had not been identified. For example, one table proposed that Codes and Standards identify the criteria to which appliance manufacturers should respond.

A final point was made that the focus in marketing of any new equipment should not be on the potential for problems, but rather on the opportunity for better environmental control within the home.

4.2.4. Issue 4: Codes and Standards

The co-chairman's summary for Issue 4 (Codes and Standards) was presented as follows:

- Codes do not reflect current understanding of venting in the house as a system.

- Committees do not represent the industry.
- How is code response to technology to be speeded up without trying to lead?
- How do we ensure communication between users of the codes and code writers?
- How do we get trained personnel who are knowledgeable of the code requirements?
- The code is only as good as the interpretation and the enforcement.
- No individual groups should be able to unduly influence the code.

Three tables (13, 9, 8, 14) were asked to suggest possible problems and solutions corresponding with the above-stated issues. A summary of their findings follows:

Lack of Understanding of House as a System in Codes

The general opinion was that the existing codes were not in conflict with current understanding although certain changes are warranted (e.g. control of depressurization, air quality, and humidity levels should be built into the applicable codes). For example, one table discussed that the NBCC recognizes venting as necessary, however, there is no co-ordinated code group which is mandated to look at the house as a system. Another table further suggested that there was a need for better co-ordination beyond the technical sub-committee level. It was suggested by this group that the NBCC would be the most appropriate co-ordinating agency (or the Standard Council of Canada). (There was some disagreement about the CSA) The last table suggested that an air quality committee, representative of the total industry, should be involved in code revisions. Any rules should be accompanied by a description of the intent to allow for different applications.

Committees do not Reflect Industry

All groups were able to suggest a means to improve industry representation on committees. One table suggested that it may be tough to get industry representation at the committee level, however, there is a need to improve public review. Another table expressed the opinion that, at the present time, the NBCC does not have adequate representation from the gas industry.

The last table suggested that there is a need to define and categorize the "industry" with respect to the role that each should play. For example, a utility may play a different role compared to an installer since the utility has a longer-term commitment to the customer. Vote representation on the committee might reflect this difference. What should be emphasized is the communication within and between each segment of the defined industry.

Speedup Code Response without Leading

All three groups responded to this question with the following comments:

- Codes should lead in areas of health and safety. Is too much time spent on legalese? Instead, interim "intentions" may be more acceptable. Code response must be at the initiative of the committee members;
- The NBCC allows for emergency revisions;
- Communication between the industry and code committees should be on-going.

Communication

Several suggestions to improve communication between users of the code and code writers were proposed:

- Ensure that the right people are on the committees and allow sufficient time and resources to communicate;

- Ensure that code writers understand field problems and the practicality of what can be done;
- Communicate intentions as well as the rules;
- Have more industry forums to discuss upcoming changes to the Code;
- Speed up communication to industry, and vice versa, so that change can be effected sooner, if warranted;
- Inform the public by communicating with the daily newspapers.

Trained Personnel

Two tables responded to the issue of training personnel to become knowledgeable of the code requirements. The following comments were tabled:

- There are several options for training of personnel:
  a) Technical schools b) Night courses c) Industry trainers
  d) Government or regulatory agencies;
- There must be an examination process that assesses knowledge;
- How can the builder (CHBA) be a part of training?
- There must be a greater involvement by code writing officials to impart information to all levels of code users. This includes the trades through their apprenticeship program.

Interpretation and Enforcement

Each of the three tables responded to the issue of interpretation and enforcement of the Code. The following comments were recorded:

- Writers of the codes should be responsible for interpretation and communication. These interpretations (or better still

intentions) must be communicated to no less than the enforcing group and, if at all possible, be part of any proposed training package;

- There should be an attempt to write the Code to be easier to interpret and each standard should be issued with a commentary in order to clarify the intent and provisions of the standard. Presently, the rationale behind many provisions are not communicated;

- Code writers are now developing commentaries to support part of the NBCC (Part 3 and 9). These commentaries are being written in lay language and describe the history and development of the Code.

Undue Influence

All three tables agreed that no one individual group should be allowed to unduly influence the Code, however, the general feeling was that this is not presently a problem. It was suggested by one group that the present make-up of many standing committees acts as a minor deterrent to undue influence and that there is a further check at the level of the Associate Committee which represents a broad range of groups.

4.3 Action Plan Summaries

Participants were asked to form new groups based on membership in one of the seven following professional categories:

Fuel Safety
Building Code
Standards and Testing
Manufacturers
Utilities
Research
Others

The newly-formed tables were asked to develop action plans which addressed the four issues (knowledge, training, appliances, codes) which had been discussed during the previous two discussion sessions.

4.3.1 Building Code Action Plan

The Building Code group chose to formulate their action plan in reference to the seven summary issues/implications statements.

Codes do not reflect the current understanding of venting of the house as a system.

This statement is only partially true. The B149 Code does say that if there are competing devices which could affect the combustion air of an appliance, the correction must be approved by the enforcing authority.

The draft standard on Ventilation Requirements for Residential Construction (CSA F326) is currently being developed. It will be reviewed by Part 6 as to mechanical and electrical design and Part 9 from the building industry point of view.

Since exposure guidelines for residential air quality are not yet released, they were released August 14, 1987* , they will probably be looked at but will not be referenced as a standard for some time. ASHRAE 62-81R on indoor air quality should not be referenced, so that if there is a referenced document, it will be Canadian.

*The guidelines were released August 14, 1987 and are available from the Communications Directorate, the Department of National Health and Welfare, 5th floor, Brooke Claxton Building, Ottawa, K1A 0K9.

Committees do not represent the Industry

There is a conscious effort that all interested groups be represented based on technical expertise and territorial representation. It is suggested that there be an open opportunity to apply, but that all interested parties be screened to ensure a proportional industry representation.

How to speed up code response to technology without trying to lead

Standards should closely follow but not lead. The NBCC has the mechanism in place to respond to emergency safety and health needs but the need has to be very clear. The issues presented at this forum are not thought to be in this emergency category.

How do we ensure communication between users of the codes and code writers

Form a liaison committee for indoor air quality comprised of the CGA Indoor Air Quality committee, the Canadian Electrical Association, CMHC, CHBA, the NBCC, CSA, ULC, etc., to resolve the various interfaces.

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* The guidelines were released August 14, 1987 and are available from the Communications Directorate, the Department of National Health and Welfare, 5th Floor, Brooke Claxton Building, Ottawa, K1A 0K9.

How do we get trained personnel, knowledgeable of the code requirements

Currently there are "dog and pony shows" that the NBCC sponsors and delivers, where code changes are presented and explained. There are also a number of information releases which outline code changes. There is some room for improvement here.

The Code is only as good as its interpretation and its enforcement

It is imperative that codes be very carefully written. Interpretation has to be undertaken by building inspectors, up the line to management if necessary. Any one can write to the NBCC for interpretation and rationale of the articles and sentences. Currently NBCC is writing a commentary on proposed changes to Part 9 and it is proposed a commentary also be written on Part 3.

No individual groups should be able to unduly influence the Code

There is agreement with this statement but it is not presently felt to be a problem.

Summary Comments

There is a need for a clearer writing of the Code. The local inspector is responsible to interpret the Code and there is available to him/her back up technical assistance. There are no forces currently unduly influencing the Code. There is a need to ensure a combined and broad cross-section of expertise and industry representation by screening and selecting committee members from a wide "open-door" application process.

4.3.2 Fuel Safety Action Plan

In new housing, depressurization is a building problem, therefore, the B149 committees should be encouraged to identify building code changes.

Gas installations installed to the B149 Code operate properly until affected by exhausting devices installed by others.

Education programs should be developed to make homeowners aware of problems that may arise from added insulation, sealing of the home, or installation of exhausting appliances.

If building code personnel do not address problems created by depressurization, fuel safety branches may be forced to develop regulations which may be undesirable to some parts of the building industry.

Initiate educational programs for inspectors and installers to make them aware of the concept of the house as one complete system.

Information collected by fuel safety personnel at this meeting will be passed on to our individual branches for further discussion and program development, if necessary.

4.3.3 Standards and Testing Action Plan

Recommendations:

- Standards and codes should include the intent and interpretation of the regulation. Mechanisms should be put in place to distribute the intent/interpretations to all enforcing authorities (at a minimum).

- The NBCC should set up a co-ordinating committee/subcommittee to review (on an on-going basis) the co-ordination of the NBCC with all referenced standards/codes. The co-ordinating group should consider and use the house-as-a-system concept and examine any conflicts in referenced codes and standards and recommend to the applicable committee a method of resolving differences. It is

anticipated that this co-ordinating committee would significantly influence the work of all standards groups.

- Standards should closely follow but should not lead. There is potential for considerable danger and confusion when standards lead. Mechanisms do exist for responding to new technology quickly (e.g. annual method of changing codes, emergency procedures, and interim requirements can be developed quickly and as an interim step to formal product standards). However, it is possible that awareness of these mechanisms must be improved. In addition, the co-ordinating committee should possibly have a procedure for expediting code changes.

- A formal procedure should be established to deal promptly with requests for interpretation of codes and standards provisions.

4.3.4 MANUFACTURERS' ACTION PLAN

Three tables were involved in formulating an action plan for manufacturers. Each table was reported to have had a different viewpoint, a summary of which is presented below:

- Manufacturers will respond to safety-driven code changes and to market opportunity. The action plan recommendation is to **encourage manufacturers to have greater involvement in the code and standards writing process** so that they are better able to identify and respond to market opportunities. Said another way (by another table), manufacturers must increase their participation in forming the codes to ensure that they are not put in a position where they cannot respond to the needs of the marketplace.

Some specific suggestions:

- Manufacturers should provide more representation and be more alert and participative in code committees and forums;

- Manufacturers must receive continual updates on new research and be asked to respond prior to action being taken;

- A mechanism for pulling manufacturers together may be the manufacturers committees of HRAI and CHBA;

- Improve the timeframe required to amend codes;

- Harmonize common North American standards (CSA, ULC, ULI, AGA, CGA) so that the requirements are common. This will help to speedup approvals;

- Monitor and reduce approval costs for new products and pass any savings on to the consumer;

- Commit resources for training and education. Specifically, initiate customer training and education regarding the proper use of the product;

- The problem concerns not only venting, but also the broader issue of indoor air quality and control of contaminants. Therefore, ventilation and replacement or some form of contaminant removal must be present even when fuel-burning appliances are not in use. Ventilation must be controlled and there should be recovery of heat where practical;

- The ventilation system must be required to compensate for a homeowner retrofit. It must maintain acceptable comfort throughout the structure. Power-vented appliances would solve spillage concerns but contribute to negative pressure unless isolated or directly supplied with outside air;

- The technology for combustion appliances and ventilation equipment is established. An industry committee should be established to determine those appliances (and interior materials) that contribute significantly to indoor air quality problems so that they can be redesigned within a reasonable timeframe and reasonable cost;

- In the short term (6 months), standard changes must be proposed for better ventilation. A committee should be established to evaluate pollutant sources;

- In the medium term (2-3 years), interim changes to appliance standards should be proposed for review and comment;

- In the long term (5 years), codes should specify that any appliance that removes air from the house should provide make-up air.

4.3.5 Utilities Action Plan

Three tables were involved in the formulation of an action plan reflecting the utilities. The Canadian Gas Association (CGA) has a position paper on indoor air quality which also reflects the opinion of the three groups. Additional comments and recommendations are summarized below:

- Support an increased level of involvement with the National Building Code of Canada in dealing with the house as a system concept, through B149 committee representation. Seats should be assigned to the industry - not to individuals;

- Do not support the use of temperature dot (APTECH TYPE) sensors on gas equipment;

- This group applauded the forum initiated by CMHC and saw it as an opportunity for stakeholders to express opinions and formulate action plans. The groups were grateful for the research and said that the research information has increased comprehensive understanding. Utilities are interested in, and committed to, using a co-operative approach and to working with CMHC in an economical and practical manner.

4.3.6 Researchers Action Plan

Recommendations for additional research include:

- Compile a summary of issues by asking relevant representatives from groups such as utilities, regulatory bodies, and manufacturers to gather and assess technical information currently available and to determine areas required for further research;
- Develop a step-by-step approach, not a panic approach;
- Clearly define the short and long-term impact of sources and causes of pollution on indoor air quality, to determine if spillage has a significant effect;
- Conduct research on corrective measures which are appropriate to a particular situation and which are cost-effective, such as ventilation systems, interlocking appliance controls, etc.;
- Determine if there is sufficient technical understanding of how the house operates as a system and recommend appropriate research if necessary.

4.3.7 "Others" Action Plan

Individual members from this group included representatives from CHBA, Quebec and British Columbia Housing Authorities, Energy Mines and Resources, and HRAI. This group attempted to formulate an action plan for new, retrofit, and existing housing, but was only able to complete an action plan for new housing:

- New housing should be treated with a house-as-a-system approach;
- The NBCC should be directed to develop Part 9 to reflect the house as a system in design, possibly with guidelines. This

would mean reconsolidation of HVAC from Part 6 back to Part 9;

- Consider "Measures for Energy Conservation" as a model document to use regarding house-as-a-system design. Develop this in consultation with industry;

- All standards should be reviewed and revised once agreed upon;

- Training should be directed at designers, installers, contractors and sub-trades, housing inspectors, and educational institutions - cost to be shared by industry and government;

- Homeowner awareness programs should be cost-shared between government and industry. The homeowner will have to be advised as to what not to do in existing houses.

5. CLOSING SUMMARIES

Section 5: CLOSING SUMMARIES

The four Forum co-chairpersons were asked to provide summaries of the one discussion periods held during the previous two days. Closing summaries were provided by:

Dave Robertson (representing manufacturers)
Doug Geddes (representing the HRAI)
John Graham (representing the gas industry)
Jim White (representing government)

5.1 Manufacturers Viewpoint

Dave Robertson began by indicating that he supported the action plan as presented by the manufacturers' round table, but expressed some concern over the suggested timeframe. For example, the action plan had indicated that a pollutant standard be ready in six months. He expressed concern that six months was not sufficient time to let people react to any proposed new standards.

Mr. Robertson said that the Forum was an excellent communications vehicle for everyone. However, he commented that so often we fail at communications, in spite of its importance. For example, much has been said about insufficient communication of the codes yet Mr. Robertson was surprised to learn that a significant number of people at the Forum were unaware of the CGA B-149 standard, originally published in January, 1986, which requires standard furnaces to have vent safety or spill switches. Mr. Robertson took this as evidence of a communications problem.

Mr. Robertson expressed concern about the lack of evidence of the problem. He was not comfortable in reacting in the short term by making significant code changes based on what at this point is only a perceived combustion venting problem. Given the lack of a clear problem definition and given that protective devices are installed at least on some furnaces, Mr. Robertson recommended that no specific action be taken in the short term except to ensure co-ordination of on-going data collection. In terms of broader indoor air quality problems, Mr. Robertson suggested that some or all of residential mechanical systems will require significant changes (in the long term).

Regarding pollutant level maximums, Mr Robertson expressed concern, as a citizen, consumer, and manufacturer, that setting standards that are acceptable to both the general public and persons with hyper-sensitivities would represent an excessive and expensive measure of protection for the majority of people.

Should the CSA ventilation standard be implemented and depressurization not permitted, then it will likely be determined that there is sufficient air for combustion and for venting and that all of the concerns of backdrafting will be gone.

"As a manufacturer, profit is made by fulfilling a need or solving problems." However, Mr. Robertson felt that the consumer does not perceive any need, either from an indoor air quality or a venting perspective. The manufacturers will likely fail in trying to introduce a product to meet a need that does not exist. Therefore, the problem must be defined and requirements mandated in order for manufacturers to respond.

Mr. Robertson expressed some concern over the complexity of the house as a system principle. Further, he was concerned that it may be so complex that it cannot be successfully resolved. He suggested that, instead, perhaps each appliance should be reasonably self-sufficient, which would allow for some integration of systems. He further indicated that the industry would be able to respond to this need.

As a summary comment, Mr. Robertson expressed the opinion that there was no need for panic, and that there was sufficient time to wait for indoor air quality concerns and venting issues to be better defined. Manufacturers could then further define requirements for appliances and develop these products in response.

5.2 HRAI Viewpoint

Mr. Doug Geddes expressed the concern that there is still a lot to learn in spite of money spent on research to date. The key issue that has to be settled is: whether the occurrence of spillage is increasing, given that houses are becoming tighter.

Mr. Geddes felt that more research is required to determine the practical remedial measures.

Mr. Geddes commented that appropriate products should be available for installation, particularly for existing houses. In new homes, proper design criteria can address the safe operation of the house as a system. In retrofit housing, there is a greater potential for a problem to occur. Perhaps appliances should have some stand-alone capability, given the difficulty of training and reaching people that install equipment in existing homes.

Training requirements were the subject of much discussion — the importance of appropriate training being stressed. Mr. Geddes offered some comments and suggestions regarding training:

- There has to be an incentive for training. For example, a code requirement can provide an incentive to trades, whereby training helps them in meeting that requirement. HRAI considers that this approach works well;

- Industry is the appropriate vehicle to deliver training, but government assistance in the development of training materials and programs will be required;

- Training should be delivered on a fee/user-pay basis — the fee set at a cost-recovery level.

Regarding house as a system and the codes, Mr. Geddes considered that codes and standards should be co-ordinated and need to reflect the house-as-a-system principle. Specifically, the discussion groups placed considerable emphasis on the need for the NBCC to be a co-ordinator of house-as-a-system regulations. Mr. Geddes was of the opinion that a prescriptive requirement (reflecting house-as-a-system understanding) is needed in Part 9. Mr. Geddes suggested that the typical residential code user does not want to deal with a

performance criteria, but instead would prefer that requirements are clearly stated in step-by-step terms. Again, Mr. Geddes reflected that a similar approach for the installation of mechanical systems works well where the requirements are spelled out very clearly in prescriptive terms, but if a more creative solution is desired, it can be determined by referencing ASHRAE.

Mr. Geddes suggested that there is a need to have installation instructions for exhaust equipment indicate the potential impact on the rest of the house.

5.3 Utilities Viewpoint

Mr. John Graham began by expressing a concern similar to the manufacturers', that utilities can get priced out of business. Utilities have a vested interest that their customers are not burdened with undue capital cost or "nuisance" features. Utilities want to avoid having their customers face unnecessary costs or hassles, yet also do not want to get in the way of neccessary progress.

Regarding training, everyone was clearly in support of more training. Typically, when a field performance problem occurs, it is not the installer, manufacturer, or the code maker, but the utility that "ends up on the hook." Therefore, the gas industry is already very aware of the importance of training. Consumers Gas has already spent approximately $300,000 on the training of service personnel and the Canadian gas industry is spending up to $1.5 million annually on training.

Mr. Graham strongly supported increased public awareness of what a house and its equipment requires. Maintenance of equipment is a major area where homeowners fail. He also noted that the discussion groups had strongly expressed a need for improved communication and greater participation of everyone who is involved in regulations and codes. Mr. Graham said that he would be going back to his company recommending that they review their involvement.

Mr. Graham was concerned that there is insufficient familiarity with, or understanding of, the problem and used the issue of the determination of residential contaminant standards as an example of where "we may be going too far", given an insufficient understanding of the issue.

Mr. Graham expressed confusion relating to a statement that he thought he had heard expressed during the Forum that; carbon monoxide and safety isn't a problem anymore, it's just a health issue. He responded to this by asking; "Is a health issue just a safety problem that happens a long time down the road?"

Mr. Graham also expressed that having attended the Forum, he felt more confused than knowledgeable about the seriousness of the problem. Mr. Graham suggested that even more work needs to be done, on a consultative basis with manufacturers, utilities, and government.

Mr. Graham applauded the suggestions made by the discussion groups regarding information sharing, expressing the opinion that much can be learned from the sharing of information, both from within the same industry (e.g. utilities) and between industries. Mr. Graham considered that the installers represent a great information source as to what is really going on.

5.4 Government Viewpoint

Jim White began by clarifying how exposure guidelines are developed with respect to sensitivities and extent of exposure.

Mr. White confirmed what was expressed by many of the Forum participants, that the existence of, or lack of, a combustion spillage problem has not been adequately proven.

Mr. White expressed that variable criteria against which the concept of "a problem" is defined should be determined For example: is any spillage, if it continues, a problem? If spillage occurs often, what is a significant length of time that people would consider acceptable? What is the perception of the term acceptable? If some spillage is acceptable, what are the acceptable levels of contaminants and for how long?

Mr. White suggested that several sources of information should be accessed, e.g. utilities, and that information should be exchanged among various groups.

Mr. White indicated that there is a key need for co-ordination. The CMHC has previously tried to co-ordinate the research it undertakes, but there exists a real challenge to continue to co-ordinate due to the involvement of so many players (e.g. government, codes and standards personnel, inspection and enforcement authorities, trades, utilities, manufacturers, and the public). Mr. White expressed that "the system will work if the communications is good enough."

Mr. White commented on public awareness and expressed that it is important to determine appropriate solutions before informing the public. It is also necessary to be sure that equipment is available, people are trained, and codes and standards are in place.

Mr. White noted that manufacturers need a clear definition of the needs and sufficient lead time in order to react to those needs.

Mr. White indicated that the government must understand that codes and standards can neither lead nor lag in matters of health and safety. Further, governments will be expected to support or finance training.

Mr. White indicated that several of the discussion groups suggested that indoor air quality can be approached as an opportunity for improved living conditions and not as a set of problems that need to be solved.

Mr. White then commented on, and summarized, the action plans presented by each discussion group:

- Government should advise manufacturers of research and provide an opportunity to review and comment;
- Work is needed on sources of pollutants;
- Utilities want to input into the research;
- A review of research needs and priorities should occur quickly;
- The possibility of simplifying the house-as-a-system concept and its implications, should be assessed, so that everyone can use it;
- Codes and standards should be reviewed to assure compatability of assumptions.

APPENDIX A

LIST OF DELEGATES AND TABLE ASSIGNMENTS

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